Claims

1. A fuel injection device (10) for an internal combustion engine, having at least two valve elements (16, 18), each of which has a hydraulic control surface (32, 34) acting in the closing direction associated with a hydraulic control chamber (38), having a control valve (72) that influences the pressure in the control chamber (38), and having loading devices (20, 22) that are able to act on the valve elements (16, 18) in the opening direction, in which the valve elements (16, 18) react at different hydraulic opening pressures prevailing in the control chamber (38), characterized in that the control valve (72) is able to set at least three different pressure levels in the control chamber (38): all of the valve elements (16, 18) are closed at a comparatively high pressure level; one valve element (18) is open at a medium pressure level; and all of the valve elements (16, 18) are open at a comparatively low pressure level.

2. The fuel injection device (10) according to claim 1, characterized in that the control chamber (38) is connected to a high-pressure connection (42) via an inlet throttle (56) and the control valve (72) is connected to the control chamber (38) on the one hand and to a low-pressure connection (58) on the other.

3. The fuel injection device (10) according to claim 2, characterized in that the control valve (72) has a switching chamber (60) with a switching element (70), which rests against a first valve seat (76) leading to the low-pressure connection (58) in a first switched position (84), rests against a second valve seat (82) leading to a bypass conduit (68) in a second switched position (86), in which position the bypass conduit (68) is connected to the high-pressure

connection (42), and does not rest against either the first valve seat (76) or the second valve seat (82) in a third switched position (100).

4. The fuel injection device (10) according to claim 3, characterized in that in the third switched position (100), the control valve (72) constitutes a throttle that restricts the flow toward the low-pressure connection (58).

5. The fuel injection device (10) according to one of claims 1 or 2, characterized in that the control chamber (38) is connected to the high-pressure connection (42), the control valve (72) is connected to the control chamber (38) via at least two control conduits (62a, 62b), and the control valve (72) disconnects all of the control conduits (62a, 62b) from a low-pressure connection (58) in a first switched position (76), connects one control conduit (62b) to the low-pressure connection (58) in a second switched position (82), and connects all of the control conduits (62a, 62b) to the low-pressure connection (58) in a third switched position.

6. The fuel injection device (10) according to claim 2, characterized in that the control chamber (38) is connected to a high-pressure connection (42), the control valve (72) connects the control chamber (62) to a low-pressure connection (58) in a first switched position (86) and disconnects the control chamber from it in a second switched position (100), and it is possible to continuously switch the control valve (72) back and forth between the first switched position (86) and the second switched position (100).

7. The fuel injection device (10) according to claim 6, characterized in that it is possible to trigger the control valve (72) so that the continuous changing causes the pressure in the control chamber (38) to fluctuate around a medium pressure level.

8. The fuel injection device (10) according to claim 6, characterized in that it is possible to trigger the control valve (72) quickly so that the continuous changing yields a constant, medium pressure level.

9. The fuel injection device (10) according to one of the preceding claims, characterized in that the valve elements (16, 18) are coaxial to each other and an axial boundary surface of the control chamber (38) has a sealing region (36) which, in an open end position of the outer valve element (18), subdivides the control chamber (38) into an outer region connected to the high-pressure connection (42) and an inner region connected to the control valve (62).

10. The fuel injection device (10) according to one of the preceding claims, characterized in that the control valve (72) includes a piezoelectric actuator (80).

11. The fuel injection device according to claim 10, characterized in that the control valve includes a valve body (70) that is hydraulically coupled to the piezoelectric actuator (80); leakage fuel emerging from a guide of at least one valve element (16) is used as the hydraulic fluid.

12. The fuel injection device (10) according to one of the preceding claims, characterized in that one valve element (18) has a catch (126) that acts on the other valve element (16) in the opening direction.

13. The fuel injection device (10) according to claim 12, characterized in that the catch (126) is embodied so that it strikes the other valve element (16) shortly before the one valve element (18) reaches its maximum stroke.

14. The fuel injection device (10) according to one of claims 12 or 13, characterized in that the loading device (20) acting in the opening direction of the other valve element (16) and the hydraulic control surface (32) of the other valve element (16) are matched to each other so that this valve element (16) opens only if the catch (124) of the one valve element (18) exerts an additional force acting in the opening direction.

15. A method for operating a fuel injection device (10), characterized in that in a fuel injection device (10) according to one of claims 1 through 4, in order to open only one valve element (18), the control chamber (38) is first connected to a low-pressure connection (58) and then, is simultaneously connected to the low-pressure connection (58) and a high-pressure connection (42).

16. A method for operating a fuel injection device (10), characterized in that in a fuel injection device (10) according to one of claims 1 through 4, in order to open only one valve element (18), the control chamber (38) is first connected to the low-pressure connection (58) and is then additionally connected to the high-pressure connection (42).

17. A method for operating a fuel injection device (10), characterized in that in a fuel injection device (10) according to claim 6, the relay valve (72) is closed shortly before the pressure in the control chamber (38) has fallen far enough for the inner valve element (16) to open, and is opened again shortly before the outer valve element (18) closes.